PATENT SPECIFICATION

(11) 1 264 494

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NO DRAWINGS

(21) Application No. 21936/69 (22) Filed 30 April 1969

(31) Convention Application No. 29033 (32) Filed 30 April 1968 in

(33) Japan (JA)

(45) Complete Specification published 23 Feb. 1972

(51) International Classification G 03 g 13/20 13/08

(52) Index at acceptance

G2H 5DY 5G1Y 5G2G1 5G2G4 5G2GY 5G2Y 5G4C 5G4D 5G4E 5G4Y 5GY 5Y 7D 7Y

(54) IMPROVEMENTS IN AND RELATING TO ELECTROPHOTOGRAPHIC PRINTING PROCESSES

PATENT RULES 1968

SPECIFICATION NO 1264494

The following amendment was made under Rule 94(3) on 17 January 1973

Page 1 Heading delete (31) Convention Application No 29033 (32) Filed 30 April 1968 in (33) Japan (JA)

Page 1, delete lines 1 to 3 insert (71) I, Derek George Taylor, a citizen of Lyon House, Lyon Road, Harrow, Middlesex, England, do

Page 1, line 4 for we read I

Page 1, line 5 for us read me

THE PATENT OFFICE
21 February 1973

However, this method cannot be used in conventional printing techniques because suitable thermoplastic copy material is not generally available. An alternative was proposed of incorporating in a toner a [illegible] and which substance when molten acts a solvent for the binder, and subjecting th toner image to a high frequency electric fiel to melt the substance whereby to dissolv the binder to enable the binder to bind th pigment to a substrate.

SPECIFICATION NO 1264494

By a direction given under Section 17 (1) of the Patents Act 1949 this application proceeded in the name of KABUSHIKI KAISHA RICOH a Japanese Body Corporate of 3-6 1-Chome, Nakamagome, Ohta-Ku, Tokyo, 143, Japan.

THE PATENT OFFICE

R 16436/

Toners comprising various thermoplastic materials and carbon black or other pigments are currently commercially available, but it is difficult to fix a toner, for example, having a dielectric loss factor 10^{10} times that of polystyrene by means of a high frequency electric field without the use of a high frequency having an electric field strength which could be generated only by a very costly and powerful apparatus.

A proposal has also been made to add to

that of the binder in the toner. The substanc is solid at room temperature but has melting point lower than the softening o carbonisation temperature of the substrate i the form of a copy sheet. Furthermore th substance in its molten state acts as a solven for the binder in the toner.

According to DIN 53.453, the dielectri loss factor (power factor x dielectri constant) of polystyrene is about $3 \times 10^{-}$ while that of acetanilide is extremely high

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(54) IMPROVEMENTS IN AND RELATING TO ELECTROPHOTOGRAPHIC PRINTING PROCESSES

(71) We, KABUSHIKI KAISHA RICOH, a Japanese body corporate of 3-6 1-Chome, Naka Magome, Ohta-Ku, Tokyo, Japan, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

The present invention relates to improvements in electrophotographic printing processes.

In the particular case of printing upon a low dielectric loss factor thermoplastic foil substrate, a method has been proposed for applying toner to the foil body bearing an electrostatic latent image during or after the heating of the foil in a high-frequency field thereby resulting in a toner image which has penetrated the fused or softened foil substrate and thus has become fixed in the substrate.

However, this method cannot be used in conventional printing techniques because suitable thermoplastic copy material is not generally available. An alternative was proposed of incorporating in a toner a thermoplastic material. It was found, however, that substantially all thermoplastic materials have low dielectric loss factors and therefore do not readily lend themselves to heating by high frequency electric fields. For example, in the case of polystyrene it is almost impossible to raise its temperature to the necessary level with the microwave heating techniques currently available. It was found difficult or impossible to raise the temperatures of the toner particles from 20°C to their melting or softening point at about 160°C.

Toners comprising various thermoplastic materials and carbon black or other pigments are currently commercially available, but it is difficult to fix a toner, for example, having a dielectric loss factor 10^{10} times that of polystyrene by means of a high frequency electric field without the use of a high frequency having an electric field strength which could be generated only by a very costly and powerful apparatus.

A proposal has also been made to add to the toner an inorganic substance which can be readily heated by a high frequency field so that the heat that it generates will melt the thermoplastic binder in the toner. However, this method will not necessarily bring about better results all the time. For example, it may be possible to combine light-coloured pigment with the inorganic substance of the type described above, but it is extremely difficult to do so in practice because the above inorganic substance has its own inherent colour and adversely affects the properties of the pigment carrier.

The present invention provides an electrophotographic printing process, comprising the steps of forming a toner image on a substrate with a toner comprising a pigment, a thermoplastic binder and a substance having a dielectric loss factor substantially higher than that of the pigment and binder and which substance when molten acts as a solvent for the binder, and subjecting the toner image to a high frequency electric field to melt the substance whereby to dissolve the binder to enable the binder to bind the pigment to a substrate.

In carrying out the toner fixing step, the copy material is placed within a cavity or hollow resonator which is tuned to the high frequency used and which has a configuration appropriate to the shape of the substrate on which the toner is to be fixed. The toner to be used may have a particle size ranging from 0.5 to 30μ, the bulk thereof being preferably about 2μ. As already stated, the toner contains in addition to pigment a substance or compound having a dielectric loss factor considerably higher than that of the binder in the toner. The substance is solid at room temperature but has a melting point lower than the softening or carbonisation temperature of the substrate in the form of a copy sheet. Furthermore the substance in its molten state acts as a solvent for the binder in the toner.

According to DIN 53,453, the dielectric loss factor (power factor x dielectric constant) of polystyrene is about 3×10^{-4} while that of acetanilide is extremely high.

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Molten acetanilide is moreover a solvent for polystyrene. When acetanilide is included in a toner containing a pigment and binder of polystyrene, the toner will be melted by a high frequency field having a strength much lower than that which would be acquired to melt a toner having no added acetanilide.

As a binder for the toner pigment, methacrylate polymers or methacrylate-styrene copolymers may be used instead of polystyrene. Instead of acetanilide, α-naphthol, 0 - acet - toluidide, 4 - nitro - diphenyl, 2-naphthylamine or mixtures thereof may be used. Properties common to all of the compounds described above as alternatives to acetanilide are (a) that they have dielectric loss factors considerably higher than that of the methacrylate-styrene copolymer and that of polystyrene: (b) they are solid at room temperature; and (c) in the molten state, they are solvents for the binder in the toner.

The cavity resonator is tuned to resonance at the high-frequency used for fixing. That is, the resonator is tuned by known means when the copy material bearing the toner in use is placed within the resonator. The toner image can thus be developed and fixed by the efficient use of a high frequency heating field. Even if the resonator is not tuned, the fixing process may still be carried out, but at a lower efficiency.

Attention is directed to the fact that the use of 4-nitrodiphenyl and 2-naphthylamine is subject to Carcinogenic Substances Regulations 1967.

WHAT WE CLAIM IS:—

1. An electrophotographic printing process, comprising the steps of forming a toner image on a substrate with a toner comprising a pigment, a thermoplastic binder and a substance having a dielectric loss factor substantially higher than that of the pigment and binder and which substance when molten acts as a solvent for the binder, and subjecting the toner image to a high frequency electric field to melt the substance whereby to dissolve the binder to enable the binder to bind the pigment to a substrate.

2. A process according to claim 1, wherein the step of subjecting the toner image to the high frequency electric field comprises the steps of placing the substrate carrying the toner image within a cavity resonator which is tuned to resonate with the high frequency electrical field and which has a configuration appropriate to the shape of the substrate, and then energising the resonator.

3. A process according to claim 1 or to claim 2, in which the toner material has a particle size ranging from 0.5μ to 30μ.

4. A process according to claim 3, in which the bulk of the toner material has a particle size substantially of 2μ.

5. A process according to any preceding claim, in which the substance comprises acetanilide.

6. A process according to any one of claims 1 to 4 in which the thermoplastic substance comprises α-naphthol.

7. A process according to any one of claims 1 to 4 in which the thermoplastic substance comprises o-acet-toluidide.

8. A process according to any one of claims 1 to 4 in which the thermoplastic substance comprises 4-nitrodiphenyl.

9. A process according to any one of claims 1 to 4 in which the thermoplastic substance comprises 2-naphthylamine.

10. The electrophotographic printing process according to claim 1 and substantially as hereinbefore described.

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